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Federal Guidelines

Operation and Maintenance

of Wastewater Treatment Facilities

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Water and Hazardous Materials
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These guidelines pertain only to the Operation and Maintenance of Wastewater Treatment facilities and includes titles on Staffing and Training, Safety, Emergency Operating Plan, Maintenance Management, and Budget.

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FOREWORD

This supplement updates and replaces pages 31 through 46 of the Federal Guidelines - Design, Operation and Maintenance of Waste Water Treatment Facilities, dated September 1970 and concerns only that portion of the Guidelines pertaining to the operation and maintenance of wastewater treatment facilities.

Several new subject areas have been added to comprehensively cover all elements commonly identified with the Operation and Maintenance of wastewater treatment facilities. The supplement has been expanded to include titles on Staffing and Training, Safety, Emergency Operating Plan, Maintenance Management, and Budget.

It is becoming increasingly evident that there is a vital need to include more comprehensive operation and maintenance considerations in the early stages of project development. This is vital to insure that the huge investments in construction of wastewater treatment facilities result in treatment capability that can produce a high quality effluent with a high degree of reliability.

There have been several organizations and many individuals that have contributed to the development of this supplement. The guidance provided by the Technical Advisory Group (TAG) to the Municipal Construction Division within the Office of Water & Hazardous Materials of the Environmental Protection Agency is particularily noted. TAG is composed of a representative from each of the following organizations:

American Society of Civil Engineers
Association of Metropolitan Sewerage Agencies
Association of State and Interstate Water Pollution Control Administrators
Great Lakes Upper Mississippi Board of Sanitary Engineers
U. S. Council of Consulting Engineers
Water and Wastewater Equipment Manufacturers Association
League of Women Voters
National League of Cities/U.S. Conference of Mayors
Associated General Contractors of America

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Securities Industry Association
Conference of State Sanitary Engineers
American Public Works Association
Water Pollution Control Federation

The time and effort of the various individuals and groups that contributed to the development and review of these guidelines is sincerely appreciated.

James L. Agee
Acting Assistant Administrator
for Water and Hazardous Materials

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INTRODUCTION

The Federal Water Pollution Control Act Amendments of 1972 established specific goals for controlling wastewater discharges to meet certain water quality objectives. Achieving these goals will require the expenditure of many billions in capital funds for the construction of new facilities and will also require that all treatment facilities, both new and existing, be operated efficiently and effectively to maximize our pollution control effort. Proper operation of new and modified facilities and improved operation of existing facilities are essential if our water quality goals are to be met.

The surveys conducted in accordance with Section 210 of the Act, and included as Chapter VII of both the 1973 and 1974 editions of the Clean Water Report to Congress showed that about one-third of all treatment plants constructed with Federal grant assistance were not operating at the designed efficiency level when the plants were inspected. This illustrates the improvement in plant operation that will be needed if our water quality objectives are to be achieved.

These Operation and Maintenance Guidelines are structured to emphasize a comprehensive strategy to attain the high levels of operational efficiency that are necessary to realize appropriate water quality objectives throughout the Nation. This strategy must link closely municipal permits issued under the National Pollutant Discharge Elimination System (NPDES) with the various State and Federal programs responsible for assuring that effluent quality complies with specific municipal permit conditions. This approach is consistent with the stated objectives of the Act and EPA's Water Strategy document of March 15, 1974.

Title II of the Federal Water Pollution Control Act Amendments of 1972, PL 92-500, authorizes the award of construction grants for waste treatment works. As a condition of these awards, the Act in Sections 204(a) and (b) requires that the grantee make adequate provisions for proper and efficient operation and maintenance of grant funded facilities. The Construction Grant Regulations, Title 40, Chapter 1, Subchapter B, Part 35, Subpart E, dated February 4, 1974, contain several sections that provide additional information on these operation and maintenance requirements.

Section 35.917, Facilities Planning (Step 1) calls for a cost-effectiveness analysis of alternatives for a waste treatment facility for which a Federal grant is requested. One element of the analysis, section 35.917-1 (d)(3) calls for

> "An evaluation of improved effluent quality attainable by upgrading the operation and maintenance and efficiency of existing facilities as an alternative or supplement to construction of new facilities."

In Section 35.925-10, it is stated that a grant award shall not be made unless it is determined

> "If the award of grant assistance is for a project involving Step 3, that satisfactory provision has been made by the applicant for assuring proper and efficient operation and maintenance of the treatment works, in accordance with 35.935-12, and that the State will have an effective operation and maintenance monitoring program to assure that treatment works assisted under this subpart comply with applicable permit and grant conditions."

Section 35.935-12 states:

> "(a) The grantee must make adequate provisions satisfactory to the Regional Administrator for assuring economic, effective, and efficient operation and maintenance of such works in accordance with a plan of operation approved by the State water pollution control agency or, as appropriate, the interstate agency, after construction thereof.
>
> "(b) As a minimum, such plan shall include provision for: (1) An operation and maintenance manual for each facility, (2) an emergency operating and response program, (3) properly trained management, operation and maintenance personnel, (4)

adequate budget for operation and maintenance, (5) operational reports, and (6) provisions for laboratory testing adequate to determine influent and effluent characteristics and removal efficiencies.

"(c) The Regional Administrator shall not pay (1) more than 50 percent of the Federal share of any Step 3 project unless the grantee has furnished a draft of the operation and maintenance manual for review, or adequate evidence of timely development of such a draft, or (2) more that 90 percent of the Federal share unless the grantee has furnished a satisfactory final operation and maintenance manual."

The guidelines which follow are intended to assist in meeting these specific requirements of the Act and regulations for grant assisted facility construction and to provide information on the key elements that should be included in any plan of operation for a wastewater treatment facility. More detailed information on various aspects of operational plans may be found in the source documents referenced throughout the guidelines and listed at the back of this document.

GUIDELINES FOR OPERATION AND MAINTENANCE

These Guidelines are intended to assist in assuring that all aspects related to wastewater treatment plant operation and maintenance are appropriately considered by those responsible for complying with grant requirements, specific effluent permit criteria, and related water quality standards. The Guidelines are presented categorically to accommodate their use in either the development of new facilities or in upgrading the operation and maintenance procedures and programs of existing facilities. In the development of new facilities, it is essential that the various aspects of operation and maintenance that are outlined in these Guidelines be given appropriate consideration early in the design stage and that the design address these considerations properly in producing a facility with optimum, long-term performance capability.

1.0 FEDERAL AND STATE INSPECTIONS

1.1 To provide assurance of effective, efficient, continuous operation of waste treatment facilities and related appurtenances constructed under PL 92-500 grants within their jurisdiction, State agencies shall establish and maintain appropriate waste treatment facility inspection and technical assistance programs to identify operational deficiencies and to insure that appropriate remedial action is taken to correct deficiencies. This activity shall be clearly identified in the annual State Program Plan submitted to the EPA.

1.2 State agencies shall conduct at least an annual inspection, or provide for the inspection of, facilities constructed with Federal funds to determine whether these facilities are operated efficiently and effectively in accordance with plant design.

1.2.1 The inspector shall record the following information, using EPA Form 7500-5(4-72) (revised 1/74) or the latest revised version:

1.2.1.1 General information, including: date of inspection; plant identification and locations; name of inspector and title; type of plant and collection system; estimated total population served as well as industrial population equivalents served.

1.2.1.2 Plant loading performance data, including: average daily flow (MGD); peak flow rate for wet and dry weather (MGD); percent daily industrial flow to plant; date, time and volume of any wastes bypassing the plant; and summary of laboratory analyses data on raw waste and final effluent and other significant unit processes.

1.2.1.3 Information on operating personnel, including: staff complement and qualifications of personnel in each job category; total manhours per week; number of State certified or licensed personnel; staffing deficiencies; staff vacancies; staffing needs not budgeted; training needs and annual O&M Budgets. Also included will be an

identification and narrative of any facility problem traceable to personnel or training deficiencies.

1.2.1.4 An identification and brief discussion of significant operational problems or difficulties.

1.2.1.5 An evaluation and report on the facility, including: adequacy of operation and plant performance with regard to State and Federal Permit or other requirements; general housekeeping and maintenance adequacy; testing and reporting adequacy; and recommendations for corrective actions.

1.2.1.6 Appropriate additional operation and maintenance data and information pertinent to the conditions found at the plant or elsewhere in the sewerage system at the time of inspection.

1.2.2 Copies of the inspection results shall be distributed by the State Water Pollution Control Agency to the subject waste treatment facilities; two copies to the EPA Regional Office, including a copy of the report transmittal letter to the inspected facility and/or the authority responsible for management.

1.2.3 EPA shall identify for each State by January 1 of each year those facilities the State must inspect in order to comply with Title II of PL 92-500. This list shall also identify on a tentative basis those facilities to which EPA Regional Office representatives may accompany State representatives to conduct inspections. Reasonable advance notice will be given by EPA to the State on plant inspections not previously indicated on the annual list.

1.3 In addition to thorough annual inspections as described above, routine interim inspections should be conducted by the State. The EPA Regional Office shall receive a copy of the reports on interim inspections.

1.4 Prompt and meaningful follow-up action shall be taken by the State to assure correction of inadequacies and deficiencies noted at inspections.

1.4.1 Where major deficiencies are involved, a copy of official State correspondence, notices or orders to a municipality and follow-up inspection reports shall be sent to the EPA Regional Office.

1.4.2 Wherever possible, in correcting deficiencies in operation, the State should coordinate with the design engineer responsible for the subject facility.

1.4.3 The consulting (design) engineer and the State should be involved in the start-up of new facilities.

2.0 STAFFING AND TRAINING

2.1 General Requirements

This section is included as an aid to the grantee in responding to the requirements of Section 204(a)(4) of the Act. The referenced section requires that, as a condition of a grant, the grantee will insure his facility will be adequately staffed and that it will be managed in accordance with an operational plan.

2.2 Specific Requirements by Phase

2.2.1 Facility planning phase

2.2.1.1 Analysis of Manpower Considerations

(a) Availability and skills of personnel from existing facilities which will be modified or phased out as a result of grant.

(b) New personnel skills required by proposed facility or operational alternatives.

(c) Potential staffing problems.

2.2.1.2 Recommendations to be included:

(a) Probable total staffing requirements for facility.

(b) Probable training needs and sources.

(c) General plan for staff development and training.

(d) Design considerations necessary to assure operability and maintainability.

2.2.2 Preparation of Plans and Specifications

The following staffing plan should be available in preliminary form in the design reports. Update should be made at about the 50% completion point of construction and should be finalized 60 days prior to

start-up for inclusion in the plant Operation and Maintenance manual.

2.2.2.1 Staff Development

(a) Planned staffing schedule.

(b) Salary schedules.

(c) Detailed manpower requirements for each unit process - include number, type and level.

(d) Staff structure and organization.

(e) Use of existing staff (where appropriate).

(f) Detailed analysis of new or special skills (where appropriate).

(g) Staff certification requirements.

2.2.2.2 Staff Training

(a) Training needs for initial and upgrade training, including: management, safety, operation and operational control, laboratory, maintenance and maintenance management, start-up and special equipment

(b) Training materials requirements.

(c) Training strategy and responsibilities.

(d) Training schedules for construction period, start-up and operational phases.

(e) Job and training aids required, including standard job operating procedures.

2.2.3 Construction Phase

2.2.3.1 Staffing

(a) The chief operator shall be retained by the grantee by the time construction of the waste

treatment plant is 50% complete so that he can become familiar with the plant layout, piping, underground utilities, checkout of all equipment, and to oversee staff development and training.

(b) Not later than 60 days prior to commencement of operation, the grantee shall inform the State or EPA of any problems encountered in acquiring or training personnel.

(c) Thirty days prior to commencement of operation, the grantee shall provide the State and EPA an itemized list of the positions filled, the qualifications of those employed, the assurance that the remaining vacant postions will be filled with qualified personnel as necessary for the efficient and effective operation and maintenance of the facility.

2.2.3.2 Training

(a) Within 30 days after the Chief Operator has been retained, or after the 50% completion date, whichever is later, the grantee shall submit a final training schedule for all pre-operational training activities.

(b) Thirty days prior to the commencement of operations, the grantee shall provide the State and EPA with a finalized plan (including schedules) for continuing training after start-up. This plan shall include replacement, refresher and upgrade training, as well as such special training as safety and emergency readiness. The plan also shall provide for such classroom and on-the-job training as is necessary to qualify personnel for the various positions for initial start-up of the waste treatment facility and for operation thereafter.

2.2.4 Operations phase

2.2.4.1 Staff

The grantee shall provide a staff of qualified personnel that is adequate to operate the facility efficiently and effectively. Qualified personnel shall be those meeting requirements established under State certification programs or other requirements established by the State and Federal governments.

2.2.4.2 Compensation

The grantee shall pay adequate salaries commensurate with duties, responsibilities and other conditions of employment.

3.0 RECORDS, REPORTS, AND LABORATORY CONTROL

3.1 A permanent record file for the treatment plant and collection system shall be maintained by the grantee at each of its waste treatment plants or at some appropriate location readily accessible to the operating personnel. The file should include:

3.1.1 The operation and maintenance manual for the wastewater treatment facility. (See Appendix, page 42)

3.1.2 Planning reports, design criteria and other related data.

3.1.3 All as-built plans, specifications, drawings, and manufacturers' specifications and recommendations for operation and maintenance of each unit.

3.1.4 Appropriate flow charts indicating the system process operation.

3.1.5 The NPDES Discharge Permit.

3.2 Complete and accurate plant operating records shall be maintained.

3.2.1 These records serve to guide plant operating and process control personnel and become the source of historical data on the precise performance of the facility. Plant operating reports can often be standardized, but it is of prime importance that the information and related forms be tailored to each operation in order to be effective. Significant data should also be graphed for visual display.

3.2.2 The grantee shall routinely file plant operating records with the appropriate State agency. Monthly reports of daily operating records are needed by the State regulatory agencies in carrying out their responsibilities to monitor and maintain maximum operating efficiencies.

3.3 Adequate monitoring, sampling and analysis of flows is fundamental to good operation and maintenance.

3.3.1 The influent should be monitored, sampled and analyzed so as to determine the rate of flow and characteristics of the wastewater to be treated. Effluent monitoring and reporting shall be stipulated in the NPDES permit. Optimum control of treatment processes may require up-line sampling and testing at strategic points throughout the collection system to pinpoint locations that contribute abnormal amounts of a given constituent.

3.3.2 Appropriate monitoring, sampling, and analysis shall be conducted through each process so as to indicate any adjustments necessary to provide a continuous high quality effluent.

3.3.3 The plant effluent shall be monitored to determine compliance with the discharge permit provisions contained in PL 92-500.

3.3.4 Wherever possible, the receiving water should be monitored to determine the effect of the plant effluent in relation to water quality standards.

4.0 PROCESS CONTROL

4.1 The wastewater treatment plant should be operated so as to fully and effectively utilize the flexibility in process control provided for in the plant design.

4.1.1 Plant flexibility should be used to get the maximum treatment out of the facility on a day-to-day basis. This includes making such process adjustments as may be indicated by the monitoring system.

4.1.2 The flexibility in routing flows that is provided in the design shall be used to allow preventive maintenance and repairs to be carried out without by-passing the entire treatment plant or discharging inadequatly treated wastewater.

4.1.3 A total plant bypass shall be used only as a last resort when necessary to protect the health and welfare of operating personnel or to prevent extensive damage to the plant facilities or processes or upstream property. All bypassed sewage shall be adequately disinfected. In those cases where the plant bypass must be used:

4.1.3.1 Where possible advanced approval must be obtained from the State. If this is not possible, the State must be notified of the bypass promptly by telephone.

4.1.3.2 A complete written report shall be filed with the State. This report shall include the date, time, quantity of the waste, characteristics of the waste, reason for bypassing, steps taken to prevent recurrence of the problem, and any other pertinent information considered necessary by the State.

4.1.3.3 Special notice may be required, e.g. shellfish, etc.

4.2 Plant operating personnel must be alert to any trends or changes in the characteristics of the influent, both on a long-range basis and on the short-term basis needed for day-to-day operations.

4.2.1 Operators should maintain continuous communication with plant management and appropriate regulatory agencies so that plant inadequacies are detected early, thus affording lead-time to diagnose and resolve problems before they impair quality control in the plant.

4.2.2 Provision should be made for warning plant operators promptly of any unusual flows or wastes that are discharged accidentally or otherwise to sewers served by the plant. Users shall be required through local ordinance to immediately notify waste treatment plants of any such discharges.

4.3 An effective equipment maintenance program is necessary to insure that all equipment is kept in a highly reliable operating condition. It is the responsibility of the plant management to provide sufficient funds for maintenance, repairs, spare parts, and standby equipment to keep the plant, pumping stations and related appurtenances operating satisfactorily.

4.3.1 The maintenance program should include:

4.3.1.1 The establishment of a control system which identifies and locates each piece of operating equipment, a description of the maintenance needs, a list of the general procedures for carrying out the job, and appropriate routine maintenance schedules.

4.3.1.2 A spare-parts inventory to facilitate advance ordering of unit parts vital to the continous and effective operation of the facility.

4.3.2 Plants should have a management system for recording equipment maintenance and repairs. This system should permit an evaluation of equipment performance and of future maintenance or replacement of a part or unit with one that is more reliable.

4.3.3 Preventive maintenance shall commence immediately upon installation of the equipment and not be delayed until the facility is placed in operation.

4.3.4 When possible, major maintenance jobs and repairs necessitating a shut-down of a unit shall be scheduled when it will have the least effect on waste treatment efficiency and the receiving waters.

5.0 SAFETY

5.1 PL 92-500 Basis

Section 204(a)(4) of PL 92-500 requires assurance of proper and efficient operation of facilities. Safety will be considered an integral component of such assurances. Safety of personnel, and safety and operational integrity of equipment directly affect the capability of a facility to perform its design functions. Therefore, both design for safety and safety procedures must be considered in engineering for proposed facilities.

5.2 Relation to OSHA

Section 18(b) of Public Law 91-59b, the Occupational Safety and Health Act of 1970 provides that any State may assume responsibility for development and enforcement of occupational safety and health standards. One condition under this responsibility is that the State shall assure, "... to the extent permitted by its law ... (a) program applicable to all employees of ... the State and its political subdivisions ..."

This provision ultimately will assure for participating States that all wastewater treatment facilities are covered at the State level by safety and health standards and are subject to equivalent requirements and actions to those contained in Federal legislation.

5.3 Grantee Responsibility

5.3.1 Grantees should determine the status of occupational safety and health programs and legislation in their State and provide in-plant programs that are consistent with existing or projected State requirements.

5.3.2 Construction contractors assigned the responsibilities for building facilities are already covered by the Federal legislation and are responsible for the safety and health of their employees. Therefore, it is in the grantee's best

interest to review the contractor's activities to avoid potential delays due to infractions of applicable construction standards.

5.4 Guidance Sources

5.4.1 The Environmental Protection Agency has prepared two technical bulletin supplements to these guidelines:

a. Safety in the Design of Wastewater Treatment Works

b. Safety in the Operation and Maintenance of Wastewater Treatment Works

These documents are available as aids to analyzing hazards and establishing responsive safety and health programs.

5.4.2 Other sources of aid, guidance and training are:

a. State Occupation Safety and Health Agencies

b. OSHA-Regional Offices

c. EPA Regional Offices

d. Professional and Technical Associations

6.0 EMERGENCY OPERATING PLAN

6.1 To protect the health and welfare of municipal wastewater treatment plant personnel, and to minimize adverse effects in times of emergencies, wastewater treatment facilities constructed under P.L 92-500 grants should have included in the operation and maintenance manual, a section establishing a comprehensive plan for emergency operating procedures.

6.2 Wastewater Treatment equipment suppliers should include emergency operating instructions with all equipment. This will enable the consulting engineer to incorporate this information as he prepares the operation and maintenance manual. Also, the consulting engineers, using emergency equipment instructions, may make an evaluation of equipment with regard to flexibility during emergencies. An evaluation of this type will allow plant personnel to respond more efficiently to emergencies affecting the equipment.

6.3 The plan should insure the most effective operation possible under emergency conditions.

6.4 The plan should protect the waste treatment faciiities under all foreseeable emergency conditions. It should be complete and comprehensive and should include, but not be limited to, the following:

a. Effects of Emergencies

b. Vulnerability Analysis of the System

c. Protective Measures

d. Responses to Emergencies

e. Emergency Response Program

6.5 The emergency operating plan must be periodically updated to insure current measures and responses are valid. Mutual aid agreements and notification procedures may change and must be validated periodically to enable the emergency operating plan to function properly.

7.0 MAINTENANCE MANAGEMENT

7.1 General

Section 204(a)(4) of the Act requires the grantee to provide assurance that a plant will be staffed with qualified personnel and that it will be operated and maintained in accordance with an operational plan. A maintenance management system is an essential component of the required operational plan.

7.2 Requirements

The grantee should begin development of the maintenance management system at the design stage. Components to be considered during design are:

7.2.1 Equipment numbering system should be assigned in some logical order to plant equipment so that both equipment function and location are evident in the identification number.

7.2.2 An equipment catalog should be prepared during equipment installation displaying plant identifying codes, manufacturer and vendor information, equipment description and other pertinent information.

7.2.3 Supporting equipment records should be developed as appropriate to the size of the plant. However, minimum requirements would include a maintenance log or its equivalent for each unit operation of the facility. Such records should include: equipment code and serial number; date maintenance performed; name(s) of worker(s) assigned; time required to complete scheduled or corrective maintenance; supplies/parts used.

7.2.4 Maintenance and trouble shooting guide documents for each unit process and supporting equipment.

Several of the above items are also subject to inclusion in the O&M manual. The intent of this section is not to require duplication of such items, only to assure their availability.

7.3 Other Considerations

Effective maintenance management is also a function of how well maintenance requirements and work force capabilities have been considered in facility design. An EPA source document, EPA-430-99-74-001, Design Criteria for Mechanical Electrical and Fluid System and Component Reliability, covers some maintenance design requirements.

7.3.1 In reviewing maintenance design factors, the grantee should also consider:

7.3.1.1 Maintenance safety factors affecting the protection of equipment from damage during normal and maintenance operations and the safety of maintenance personnel while working on the equipment.

7.3.1.2 The display of essential maintenance information at or near the equipment and the methods to be used for display.

7.3.1.3 Handling, removal and replacement factors to assure that appropriate clearances, connections and handling devices to expedite maintenance have been incorporated in major components.

7.3.1.4 Tool requirements avoiding need for specialized or unique tools where possible.

7.3.1.5 Alignment and keying requirements where connectors or other devices which must be precisely orientated are used.

7.3.1.6 Manual control layout requirements providing for location and design of controls to facilitate maintenance operations.

7.3.1.7 Workspace configuration covering both on site maintenance space and shop layout and design.

7.3.1.8 Accessability covering design of equipment so that all components can be reached easily and comfortably with tools and test equipment without undue effort or removal of other parts.

7.3.1.9 Special attention should be given to location and accessibility of sampling points. Junction boxes, access manholes, or pipe taps should be provided at appropriate locations.

8.0 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

8.1 The Federal Water Pollution Control Act Amendments of 1972 state that:

> No grant shall be made until the applicant has made satisfactory provision for assuring proper and efficient operation and maintenance of the treatment works after completion of construction.

8.2 The review of operating manuals will consider all factors relative to this objective. The manual must be reviewed and approved by the State and EPA at least 30 days prior to plant start-up.

8.2.1 The operation and maintenance manual shall contain a simplified schematic diagram of major pipelines, valves, and controls. Additional diagrams shall contain enlarged detail of complicated piping areas. The pipelines, valves, and controls will be clearly marked as referenced in the detailed operation procedures.

8.2.2 The various manufacturers' maintenance schedules (daily, weekly, monthly, etc.) shall be summarized with reference to the page in the manufacturer's operation and maintenance manual. Also, a cross-reference lubricant chart indicating equal lubricants produced by various major manufacturers shall be furnished.

8.2.3 In regard to types of treatment the manual will contain technical detail in simplified language, describing precisely how each process should be operated and controlled for maximum effectiveness. Manufacturer's manuals should be referenced when useful to this explanation.

8.2.4 The operation and maintenance manual shall contain emergency procedures and provide appropriate instructions to treatment facility personnel to insure that they know their assigned responsibilities for properly responding to various types of emergency

situations and thus eliminate or minimize resulting adverse effects from such incidents.

8.3 For further detail on preparation of O&M manuals see EPA publication EPA-430/9-74-001, Considerations for Preparation of Operation and Maintenance Manuals.

9.0 FINANCIAL CONTROLS AND RESPONSIBILITIES

Financial controls are an integral part of plant operation, and should be developed in advance of construction by the owner. Such controls are necessary to help management provide a system for economical and efficient operation and maintenance. Financial responsibility extends beyond the routine and obvious need for care of current public funds to the need for establishing a fund to provide for the replacement of short-lived equipment and supplies and the ultimate replacement of the plant itself.

These Guidelines are not intended to be all-inclusive. However, the items referenced are those which deserve emphasis and any system should include (but not be limited to) them.

Annual budgets should be based on All direct and indirect costs associated with the operation and maintenance of the treatment plant, including but not limited to:

9.1 Employee salaries and benefits.

9.2 Training costs for entry, update and upgrade of employees.

9.3 Operation, maintenance, administrative and ancillary equipment and supplies.

9.4 Power charges and similar expenses for utility uses.

10.0 References

The following source documents are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402:

10.1 Considerations for Preparation of Operation and Maintenance Manuals, EPA-430/9-74-001

10.2 Start-up of Municipal Wastewater Treatment Facilities, EPA-430/9/74 008

10.3 Maintenance Management Systems for Municipal Wastewater Facilities, EPA-430/9-74-004

10.4 Estimating Staffing for Municipal Wastewater Treatment Facilities, March 1973, U.S. EPA

10.5 Estimating Laboratory Needs for Municipal Wastewater Treatment Facilities, Task Order No. 5501-00651

10.6 Emergency Planning for Municipal Wastewater Treatment Facilities, EPA-430/9-74-013

10.7 Aspects of State-Wide Emergency Response Programs for Municipal Wastewater Treatment, EPA 430/9-74-014

10.8 A Planned Maintenance Management System for Municipal Wastewater Treatment Plants, EPA-600/2-73-004, November 1973

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